

# Research on Urban Environmental Infrastructure Construction and Air Pollution Based on VAR Model

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**Abstract:** With the continuous improvement of the level of urbanization and industrialization in China, the economy has developed rapidly, but at the same time, environmental pollution and air quality decline have seriously affected people's production, life and health. This article takes the relationship between Tianjin's environmental infrastructure investment and air pollution from 2004 to 2019 as the research object, uses econometric tools, and believes that there is a long-term equilibrium relationship between them. We try to find out the urban environmental infrastructure construction through theoretical and practical analysis, and make policy recommendations accordingly.

## 1 Introduction

Urban environmental infrastructure is a public service system that guarantees the normal conduct of social and economic activities in a country or region. Its social benefits are far greater than economic benefits, and are of great significance to social development. Since the reform and opening up, my country's national economy has grown rapidly. The level of urbanization has increased from 17.9% to 60.6%, and the urban population has increased from 170 million to 850 million. The rapid development of cities, and the lag in the construction of urban environmental protection infrastructure have brought about problems such as urban environmental pollution and ecological damage. Therefore, clarify the necessity and importance of urban environmental infrastructure construction, and accelerate the construction of urban environmental protection infrastructure, which is one of the fundamental measures to address urban environmental issues.

At present, the theoretical model proposed by scholar Copeland et al. (1994) believes that foreign trade and other variables are closely related to pollution emissions, and the feedback effects of environmental changes and economic development are investigated by constructing simultaneous equations. Pao et al. (2011) used data from 1980 to 2007 to study and finally proposed that the Brazilian government can increase Infrastructure investment related to energy construction, thereby reducing carbon dioxide emissions and boosting economic growth. Huang Qinghua and Jiang Song (2016) explored the investment efficiency of urban environmental infrastructure in Chongqing, and put forward policy

recommendations to improve efficiency. Chen Xiao et al. (2020) explored the relationship between infrastructure investment and China's environmental quality based on panel data empirical analysis, and found that the increase in infrastructure can significantly improve environmental development.

## 2 Current Situation Analysis

### 2.1 Investment status of urban environmental infrastructure

According to my country's current urban construction statistics, the investment scope of my country's current urban environmental protection infrastructure construction mainly includes: construction of urban sewage treatment facilities (including the construction of urban sewage pipe networks), construction of urban domestic waste treatment facilities, and urban concentration Investment in the construction of heating facilities, urban gas (artificial gas, natural gas, liquefied petroleum gas) facilities, and urban environmental greening. My country's urban environmental protection infrastructure construction investment is a major part of urban construction fixed asset investment. Table 1 shows the investment in environmental infrastructure construction in Tianjin from 2004 to 2017. The increase in urban environmental protection public infrastructure has further improved the ability of urban environmental pollution prevention and control, and has provided a strong guarantee for improving and enhancing the environmental quality of the city.

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**Table 1** Investment in Tianjin's environmental infrastructure construction(100 million yuan)

Year	EICI	Year	EICI
2004	31.1	2011	105.3
2005	28.5	2012	105
2006	17.9	2013	90.9
2007	20.8	2014	177.2
2008	35.3	2015	82.3
2009	56.1	2016	38.4
2010	65.8	2017	44.3

## 2.2 Current status of urban air quality

The current situation of environmental air pollution is mainly manifested in two aspects. First, the waste water, waste gas, and polluting raw materials of light and heavy industrial factories are discharged indiscriminately. Secondly, another major source of ambient air pollution is caused by urbanization. For example, there are a large increase in the number of cars in cities, excessive exhaust emissions, and the use of air conditioners, resulting in a large amount of carbon dioxide emissions, increasing greenhouse effect, and extreme weather.

The characteristics of environmental air pollution are mainly concentrated in the following aspects: First, the scope is gradually expanding. Not just north area, severe weather such as haze has also appeared in the south and other places. The second is that the pollution sources and pollution components are very complex. The treatment is very difficult and the treatment effect It's not big either.

## 2.3 Existing problems of urban environmental protection

### 2.3.1 Low investment efficiency in urban environmental infrastructure construction

At present, my country's urban environmental protection infrastructure construction investment subject is single, mainly relying on government investment, and the capital intervention of enterprises and the public is relatively small. In most cities, there is a serious shortage of funds in the construction and operation of environmental protection infrastructure. The construction and operation management of pollution control facilities have not introduced marketization and industrialization mechanisms. These problems have caused the construction of urban environmental protection infrastructure in my country. The key reasons for the serious lag and poor pollution control effect.

### 2.3.2 The construction of urban environmental infrastructure lags behind the development of urbanization

Due to the lack of a unified market entity with

responsibilities, powers, and interests, my country still has not gotten rid of the management and construction model of investing and constructing urban environmental infrastructure with the ownership of the whole people as the main body, that is, direct government investment and operation, from project initiation, fund raising, construction unit selection, etc. From project quality supervision to the setting of operating cost standards, the operating unit has no autonomy at all, and everything obeys the government's arrangements. As a result, the urban environmental protection infrastructure construction has lagged far behind the needs of urban development.

### 2.3.3 The price of infrastructure services deviates from the law of market value

Since environmental protection infrastructure services and operating prices are completely set by the government, the government considers more political and social stability goals, and focuses on social welfare in price setting, ignoring their commercial attributes, which leads to service operations. Prices can neither accurately reflect production costs nor accurately reflect social needs. The consequences of this are: on due to low prices, excessive consumption in the society leads to waste of resources, which further aggravates the tension of urban environmental protection infrastructure.

### 2.3.4 Monopoly operation, lack of external competition pressure

The current urban environmental protection infrastructure is mainly managed locally. Projects, plans, etc. are concentrated in the city's administrative construction department, which has a strong monopoly. It is difficult for other business entities to intervene, and there are basically no competitors. As a result, the enterprise has neither external competitive pressure nor internal development motivation, and of course there is no enthusiasm. This situation will inevitably lead to X-inefficiency within the company, resulting in the overall operating cost of the company High, poor environmental benefits.

## 3 Research Design

### 3.1 Data selection

The data in this article comes from the "China Statistical Yearbook" of the National Bureau of Statistics of China. The annual data of Tianjin's urban environmental infrastructure construction investment (B) and urban air quality (A) from 2004 to 2017 are selected, and the Eviews software is used for data processing. And analysis, through the VAR model.

### 3.2 Model setting

The Vector Auto-Regressive (VAR) model is a multivariate data analysis method first proposed by Sims

(1980). This model is not based on economic theory, but directly considers the relationship between the economic variables in the time series, and adopts the form of simultaneous multiple equations, taking each endogenous variable in the system as a function of the lag value of all endogenous variables in the system To construct the model. The general form of the model is:

$$Y_t = \mu + A_1 Y_{t-1} + \dots + A_p Y_{t-p} + \varepsilon_t \quad t=1,2,\dots, T$$

$$Y_{t-i} = \begin{bmatrix} Y_{1t-i} \\ Y_{2t-i} \\ \vdots \\ Y_{kt-i} \end{bmatrix} \quad A_j = \begin{bmatrix} \alpha_{11,j} & \alpha_{12,j} & \dots & \alpha_{1k,j} \\ \alpha_{21,j} & \alpha_{22,j} & \dots & \alpha_{2k,j} \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_{k1,j} & \alpha_{k2,j} & \dots & \alpha_{kk,j} \end{bmatrix}$$

$$\mu = (\mu_1, \dots, \mu_k)' \quad \varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \dots, \varepsilon_{kt})'$$

Among them,  $Y_t$  is the k-dimensional endogenous variable vector;  $\mu$  is the k-dimensional error vector;  $A_1, A_2, \dots, A_p$  is the matrix of coefficients to be estimated.

### 3.3 The empirical process

#### 3.3.1 Unit root test

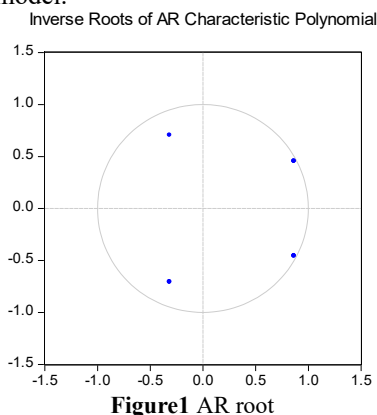
This paper uses the ADF method proposed by Dickey-Fuller to carry out unit root tests on environmental infrastructure investment (A) and air quality (B). After the first-order difference, the two series are both stationary within the 95% confidence interval, and the first-order difference of each variable has Stationarity is a first-order single integer sequence.

**Table 2** ADF unit root test

Variable	ADF test statistics	Significance level			Null hypothesis: there is a unit root
		1%	5%	10%	
A	-3.378	-2.77	-1.97	-1.60	Refuse
B	-4.137	-2.77	-1.97	-1.60	Refuse

#### 3.3.2 Test the stability of the VAR model

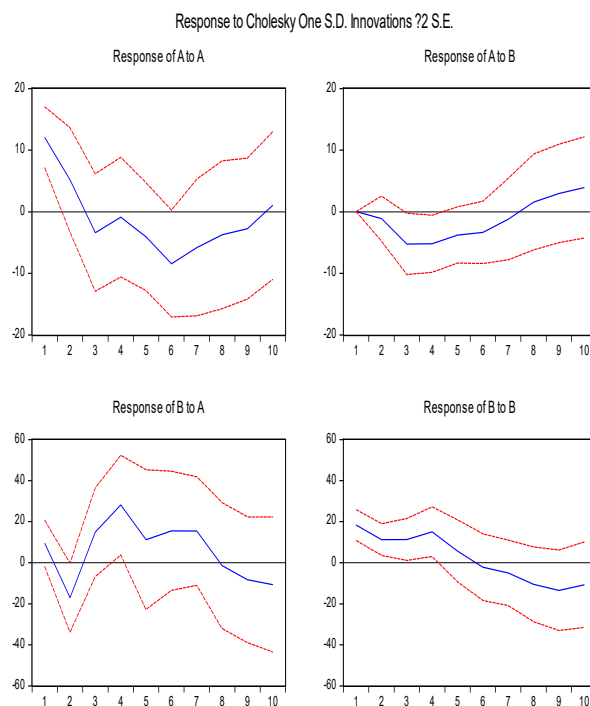
Check the stability of the VAR model. As shown in Figure 1, all the characteristic roots are located in the unit circle. The established VAR model is stable and can be estimated using this model.



**Figure1** AR root

#### 3.3.3 Impulse response analysis

The Impulse Response Function (IRF, Impulse Response Function) analysis method can be used to describe the response of an endogenous variable to the shock caused by the error term. The degree of influence produced by the current and future values of the variable. We will draw a pulse response graphic according to the dynamic changes of this variable after this impact. The impulse response function is a conditional prediction, more specifically, is a point estimate, but we will estimate the value of different points after the impact. Similar to the form of MA expression in the AR model, the VAR model also has a VMA expression form. Based on the established VAR model has passed the stability test, impulse response analysis can be performed, as shown in Figure 2.



**Figure2** Impulse response diagram of urban environmental infrastructure construction (B) and air pollution (A)

## 4 Empirical results

The impulse response analysis of urban environmental infrastructure construction (B) and air quality (A) through the vector autoregressive model (VAR) shows that the impact of urban environmental infrastructure construction on air quality is negative in the short term and negative in the long term. Internal transformation into a positive effect. This shows that the construction of urban environmental infrastructure has a long-term benign effect on air pollution and environmental protection, and investment is necessary. At the same time, the impact of air quality on urban environmental infrastructure construction also has short-term negative and long-term positive effects, which shows that in the short term, the decline in air quality will promote the construction of urban environmental infrastructure.

## 5 Conclusions and Recommendations

### 5.1 Establish an investment and financing system for urban environmental protection

Through market-oriented operation, the adoption of a multi-channel investment and financing model can speed up the construction of urban environmental protection public infrastructure. According to the law of the market economy, we should establish a multi-channel investment system and management system in urban environmental protection infrastructure, and give full play to the enthusiasm of government, enterprises, society, and foreign businessmen. By implementing investment channels, marketing and investment methods, we can maximize urban environmental protection infrastructure construction funds, and ultimately promoting urban environmental protection infrastructure construction.

### 5.2 Establish an urban environmental infrastructure construction and operation management mechanism

Governments at all levels must change the concept of urban construction and management, reform the mechanism for the construction and operation and management of urban sewage and domestic waste treatment facilities, promote and encourage various non-public ownership economies to actively participate in the investment, construction and operation of urban environmental protection infrastructure, and establish it as soon as possible. The urban environmental protection infrastructure construction and operation management mechanism that is compatible with the socialist market economy system realizes the environmental protection industry of enterprise operation and management.

### 5.3 Establish a legal person entity in urban environmental infrastructure construction

Establish a legal person urban environmental infrastructure construction investment entity, so that it has real capital operation capabilities and corporate legal person status, instead of having a corporate shell but no real capital and independent legal entity status, realizing the responsibilities, rights, and rights of the investment, the government authorizes or entrusts investment entities to be responsible for the collection, use, and repayment of urban environmental infrastructure construction funds, and implement corporate management and operation, so as to achieve high efficiency in urban environmental infrastructure financing, construction and operation.

### 5.4 Adjusting the price policy of urban environmental infrastructure

Price reform is a core issue of the urban environmental infrastructure management policy. According to the nature of the products and services, we roughly divide environmental infrastructure projects into three categories:

The first category is operable projects. Such projects have operating income, and the operating income is greater than the investment cost, such as pipeline gas; the second category is quasi-operating projects. This type of project has benefits, but the operating income is lower than the investment cost, such as urban sewage plants; the third type is non-operating projects, which have no operating income, such as city appearance and environmental sanitation facilities. We should also implement a hearing system or a price review meeting system to increase the transparency of pricing, price adjustments, and financial subsidies.

### 5.5 Improve preferential policies and relevant laws and regulations for environmental infrastructure investment

In view of the public welfare and non-profit nature of environmental infrastructure, the government should adopt special tax policies to exempt or reduce its tax burden, including zero tax rate, low tax rate, and return after collection, etc. In terms of financial policies, the government can grant discounts on loans for environmental infrastructure, making it easier for investors engaged in environmental infrastructure to obtain bank funding support. At the same time, laws and regulations related to the improvement of environmental infrastructure investment should be formulated, for example, it is clearly stipulated that garbage disposal fees are levied on domestic waste, and the sewage charging system for solid waste should be improved. In short, it is necessary to improve the relevant laws and regulations, strengthen the relevant legislation and law enforcement, so as to promote the further development of urban environmental infrastructure construction investment.

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